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## Developmental Trajectories of Externalizing Behaviors in Childhood and Adolescence

Ilja L. Bongers, Hans M. Koot, Jan van der Ende, and Frank C. Verhulst

This article describes the average and group-based developmental trajectories of aggression, opposition, property violations, and status violations using parent reports of externalizing behaviors on a longitudinal multiple birth cohort study of 2,076 children aged 4 to 18 years. Trajectories were estimated from multilevel growth curve analyses and semiparametric mixture models. Overall, males showed higher levels of externalizing behavior than did females. Aggression, opposition, and property violations decreased on average, whereas status violations increased over time. Group-based trajectories followed the shape of the average curves at different levels and were similar for males and females. The trajectories found in this study provide a basis against which deviations from the expected developmental course can be identified and classified as deviant or nondeviant.

Externalizing problem behaviors are the most common and persistent forms of childhood maladjustment (Campbell, 1995). At the same time, externalizing behaviors change so much in expression and frequency over the course of development that studies at any single point in development will provide only limited information or misrepresent the phenomenon (Kraemer, Yesavage, Taylor, & Kupfer, 2000). Therefore, there is a growing agreement that externalizing behavior must be studied from a developmental perspective (Costello & Angold, 2000). The present article aims to describe the development of various types of externalizing behaviors over age and identify groups of children and adolescents whose externalizing behaviors follow similar developmental trajectories.

### *Classification Schemes of Externalizing Behavior*

Several studies investigated the development of externalizing behavior in the general population (e.g., Hofstra, van der Ende, & Verhulst, 2000; Loeber, Green, Lahey, Frick, & McBurnett, 2000; Moffitt, Caspi, Harrington, & Milne, 2002). However, each of these used different diagnostic approaches to de-

scribe externalizing problems, including those guided by principal component analyses, consensus-based classification, or developmental theory. The present study uses an empirically derived scheme for grouping externalizing behavior problems that is interpretable from major taxonomic perspectives (e.g., *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.) [DSM-IV], American Psychiatric Association, 1994; Child Behavior Checklist [CBCL], Achenbach, 1991). This scheme, developed by Frick et al. (1993), distinguishes four types of externalizing behavior problems based on a meta-analysis of 44 factor analytic studies of more than 28,000 youths. The four behavioral clusters that emerged may be ordered along two dimensions (overt vs. covert; destructive vs. nondestructive) and were labeled opposition, aggression, property violations, and status violations. The same behavior clusters were confirmed in independent studies of adolescents (e.g., Rey & Morris-Yates, 1993).

The current work represents the first longitudinal-developmental study of the Frick clusters in childhood and adolescence. We confirmed the Frick clusters in longitudinally collected parent ratings of externalizing problems in children and adolescents. As such, it provides a replication of previous cross-sectional work but also facilitates a major step forward. First, other major classifications can be conceptually covered by the Frick clusters, which therefore may constitute an integrative framework for externalizing behavior problems. For instance, researchers who work in the CBCL tradition could profit from the clusters because the opposition and

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aggression clusters cover the aggressive behavior syndrome, whereas the property violations and status violations clusters cover the delinquent behavior syndrome. The Antisocial Behavior scale used in the studies by Moffitt and colleagues (e.g., Moffitt, 1993; Moffitt et al., 2002) is covered by opposition and property violations clusters, whereas symptoms constituting *DSM-IV* conduct disorder (CD) and oppositional defiant disorder (ODD) are subsumed under the combined aggression, property violations, and status violations clusters, and the oppositional cluster, respectively.

Second, the differentiation of externalizing behavior into these four clusters allows the investigation of different developmental patterns for different manifestations of externalizing behavior. For example, Tremblay (2000) concluded in his overview that physically aggressive behavior decreases with increasing age while other externalizing behaviors such as truancy and alcohol or drug use increase with increasing age. If different developmental patterns for the four behavioral clusters can indeed be identified, this would suggest that they are distinct from each other. Lumping externalizing problem behaviors in longitudinal studies may hamper the study of the developmental meaning of distinguishable types of behavior within the externalizing domain.

Third, distinguishing different clusters of externalizing behaviors enables the study of comorbidity of clusters and developmental pathways both within and across clusters. Several different patterns of comorbidity or developmental pathways, or both, may be distinguished, so that each may predict different outcomes. For example, studies by Loeber and colleagues (e.g., Loeber & Keenan, 1994; Loeber et al., 1993) suggest three different pathways of externalizing behavior in males that predict different delinquent outcomes. Each of these hypothesized pathways can be studied using the four behavioral clusters proposed by Frick et al. (1993).

#### *Average Development of Externalizing Behavior*

As indicated earlier, externalizing behaviors are expected to change in frequency across age. From both theoretical and clinical perspectives it is important to know when children and adolescents engage in certain externalizing behaviors and which behaviors at what frequency may be considered normative for children of a certain age. Understanding the normal development of externalizing behaviors provides an essential baseline for defining abnormality at any given age point. Using the behavioral clusters defined by Frick et al. (1993), a re-

cent cross-sectional study by Lahey et al. (2000) determined age and gender differences in parent reports of externalizing behavior problems in nearly 1,300 youth aged 9 to 17 years. They found no gender differences in opposition and status violations. However, aggression and property violations were more common among boys. The study also indicated that the levels of opposition were higher at younger ages, aggression peaked around 13 years, property violations showed no age effect, and status violations were more prevalent at older ages. The results on gender and age differences in this cross-sectional study are suggestive of actual developmental changes within individuals. In an earlier, longitudinal study on the same sample, Bongers, Koot, van der Ende, and Verhulst (2003) showed a declining trajectory of parent-reported externalizing problems (including the CBCL Aggressive Behavior and Delinquent Behavior scales) over time for both boys and girls. The aggressive behavior syndrome showed a decreasing developmental trajectory for both boys and girls. In childhood, males showed nearly twice as many aggressive behaviors as females, whereas in adolescence this difference nearly vanished. Delinquent behavior showed a curvilinear developmental trajectory peaking at age 11 years, with higher problem levels among boys than girls.

Average developmental trajectories describe the expected development of externalizing behavior for most children. However, average developmental trajectories may show considerable variation around the mean. Although some children who show high levels of externalizing problem behaviors in childhood may outgrow their problems during adolescence, other children's problems may remain at consistently high or even increasing levels during development. Therefore, it is of interest to identify groups of participants who show developmental trajectories of externalizing problems that vary in level and shape.

#### *Group-Based Developmental Trajectories*

Different developmental trajectories can be characterized by different ages of onset. For instance, the developmental taxonomy described by Moffitt (1993) distinguishes two developmental pathways of antisocial behavior. One pathway is followed by children who commit antisocial behaviors throughout their lives, the so-called life-course persisters. The other pathway is followed by children who commit these behaviors only in adolescence, the so-called adolescence limited. Patterson and Yoerger (1993) defined these different groups of children as early starters

and late starters, respectively. Loeber et al. (1993) proposed different developmental pathways that are characterized by the age of onset of overt and covert antisocial behaviors. The overt pathway is characterized by an escalation from minor aggression, followed by physical fighting, and eventually violence. The covert pathway consists first of minor covert acts, followed by property damage, and finally more serious forms of theft.

Although evidence has been found to support each of these developmental trajectories, they were not empirically derived from methodologies that determined similarities in pathways that existed in the scores from samples of children and adolescents. Instead, these categorization procedures were based on factors such as age of onset and the apparent chronicity of behavior (Loeber et al., 1993; Moffitt, 1993; Patterson & Yoerger, 1993).

New methodologies for analyzing individual-level development enable us to determine, in longitudinal data sets, distinctive groups of individuals who are more likely to follow one developmental track than another (Nagin, 1999). Several studies used these new methodologies to investigate the developmental trajectories of externalizing behaviors in boys (Brame, Nagin, & Tremblay, 2001; Broidy et al., 2003; Nagin & Tremblay, 1999). For example, four groups of boys were identified following different developmental trajectories of aggressive behavior as rated by teachers and boys themselves: a chronic group composed of 3% to 4% of the males in the sample, who exhibited stable high levels of physical aggression from ages 6 to 13, with a slight decrease until age 17; a group of nearly 30% who displayed a high level of physical aggression in childhood, declining in adolescence; a large group (50%) showing modest aggressive behaviors in childhood and none in adolescence; and a group composed of 17% of the population, who almost never committed any physically aggressive act (Brame et al., 2001; Nagin & Tremblay, 1999). Nagin and Tremblay (1999) found similar trajectories for oppositional behavior. Developmental trajectories were also investigated in a female sample (Côté, Zoccolillo, Tremblay, Nagin, & Vitaro, 2001) using a combined cluster of teacher-rated physical aggression and oppositional behavior. Again, four different developmental trajectories were identified, all showing decreasing numbers of problem behaviors over time. The problematic group included nearly 1.5% and the low group 57% of the girls in the sample. Finally, Broidy et al. (2003), using four female samples, found for teacher-rated physical aggression three different groups with mostly stable

physical aggression in childhood, the most deviant group constituting 10% of the population.

### *Research Questions*

The present study addressed three primary research questions, which are answered in a sample that has several features to enhance the generalizability of the results to other studies and populations. In contrast to other studies that used enriched or clinical samples, we used a large representative general population sample with both males and females in a wide age range. Our sample included both males and females to compare the developmental trajectories of both sexes, instead of analyzing them separately. Also, we addressed a wide age range (i.e., 4–18 years), covering the developmental transition from childhood to adolescence.

First, we tested to what extent the classifications of externalizing behavior as first suggested by Frick et al. (1993) fit the data from the present sample. To address this question, we conducted a confirmatory factor analysis (CFA) and assessed the fit of the Frick clusters to the data obtained from parent reports in a longitudinal multiple birth cohort sample. We expected an acceptable fit for both males and females.

Second, we aimed to describe the shape of the average developmental trajectories of the Frick clusters across childhood and adolescence. Based on the combined results from the Lahey et al. (2000) and Bongers et al. (2003) studies, we hypothesized that there are different average developmental trajectories for males and females for aggression, property violations, and status violations but not for opposition. Furthermore, based on the cross-sectional findings from Lahey et al. alone, we expected an average decrease in opposition, for aggression first an increase and thereafter a decrease, stable trajectories for property violations, and increases in status violations, with higher levels of problems for boys on the latter three clusters.

Our third research goal was to investigate whether groups of individuals can be distinguished who follow different developmental trajectories within each cluster of externalizing behavior. To address this question we tested semiparametric mixture models that describe different developmental trajectories within clusters. Based on the findings from earlier studies we expected to be able to distinguish reliably at least three different groups within each externalizing behavior cluster. We expected that most developmental trajectories of aggression would show a decline over age (cf. Brame et al., 2001;

Broidy et al., 2003; Nagin & Tremblay, 2001b; Tremblay, 2000). Similarly, for opposition we expected mostly declining trajectories (Côté et al., 2001, Nagin & Tremblay, 1999). However, for property violations and status violations we expected an increase for all identifiable groups (Loeber & Hay, 1997; Tremblay, 2000). Given the ubiquitous finding (e.g., Bongers et al., 2003; Lahey et al., 2000) that males exhibit more externalizing behaviors than do females, we expected more males to follow high developmental trajectories of externalizing behaviors than females, except for oppositional behavior, on which we expected an equal distribution of persistently high developmental trajectories across gender (Lahey et al., 2000). Because earlier studies indicated that the average developmental trajectories differ between males and females (Bongers et al., 2003; Lahey et al., 2000) we expected a different distribution of patterns of developmental trajectories across males and females besides the differences in overall level.

## Method

### Sample

The original sample of 2,600 children from 13 birth cohorts aged 4 to 16 years was drawn from the Dutch province of Zuid-Holland in 1983, using municipal registers that list all residents. The province of Zuid-Holland encompasses more than 3.2 million

inhabitants (20% of the Dutch population) in environments ranging from rural to highly urbanized. A random sample was drawn of 100 children of each gender and age with the Dutch nationality. Of the 2,447 parents reached, 2,076 responded and provided usable data (84.8%). For details of the initial data collection, see Verhulst, Akkerhuis, and Althaus (1985). The sample in 1983 included 1,016 males and 1,060 females. Respondents were interviewed at 2-year intervals until 1991 and again in 1997. This study uses data from the first five waves (1983–1991), during which a total of 6,932 observations were collected that are used in the present study.

Because of the age range of the CBCL, not all respondents could participate in each wave of the study. The age range was 4 to 16 years in 1983 and 1985 for the earlier version of the CBCL, and 4 to 18 years from 1987 to 1991 for the 1991 version of the CBCL. Of the 2,076 individuals who participated in 1983, only 1,149 (Cohorts 1 to 7) could participate in all five waves. For 68.8% of these 1,149 participants the CBCL was completed at all five waves (see Table 1). We kept all participants in the sample who were between 4 and 18 years of age at any time point even if data from only one wave were available. However, because of the multiple birth cohort design of the study, no single person was assessed at age 4 and age 18 (see Table 1). To investigate selective attrition, we compared dropouts and remainders with respect to their 1983 CBCL scale scores, using analysis of variance (ANOVA) and correcting for 1983 age and

Table 1  
Number of Waves per Participant

Cohort	Age range in the study	Maximum number of waves per cohort	Numbers of waves									
			1		2		3		4		5	
			M	F	M	F	M	F	M	F	M	F
1	4–12	5	5	1	2	5	5	9	7	13	62	56
2	5–13	5	2	6	5	4	4	8	12	14	55	58
3	6–14	5	6	3	4	7	5	3	5	7	58	63
4	7–15	5	2	2	6	8	8	5	5	10	57	60
5	8–16	5	7	9	7	5	7	5	11	11	57	53
6	9–17	5	5	1	9	4	4	3	14	7	49	63
7	10–18	5	10	5	2	6	5	10	14	9	47	53
8	11–17	4	7	6	4	7	12	10	55	60		
9	12–16	3	10	10	16	8	51	58				
10	13–17	3	21	16	19	18	38	49				
11	14–18	3	17	24	18	18	35	40				
12	15	1	74	70								
13	16	1	76	80								

Note. M = males; F = females.

gender. Participants with missing assessments did not differ significantly from participants with assessments available at all five waves on any of the CBCL scales.

The present sample is representative of the Caucasian population in the Netherlands. The distribution of occupational levels of the parents in 1983 was 34%, 32%, and 34% for low, middle, and high occupational levels, respectively, which is comparable to the distribution in the Netherlands. Half of the sample lived in a city, nearly 30% in a suburban area, and 20% in a rural area, which is comparable to the total population of Zuid-Holland in 1981.

### Measurements

The CBCL (Achenbach, 1991) was used to obtain standardized parent reports of children's problem behaviors. The CBCL is a questionnaire completed by parents of 4- to 18- year-olds and contains 120 items covering behavioral or emotional problems that occurred during the past 6 months; in the present study, items were mainly reported by mothers of the participants. The response format is 0 = not true, 1 = somewhat or sometimes true, and 2 = very true or often true. The good reliability and validity of the CBCL have been replicated for the Dutch translation (e.g., De Groot, Koot, & Verhulst, 1994; Verhulst et al., 1985; Verhulst, van der Ende, & Koot, 1996).

To organize the CBCL externalizing items, we used the clustering of behaviors proposed by Frick et al. (1993). For this clustering CBCL items were selected to which the content showed a good match to the description provided by the authors of the clusters (Frick et al., 1993; see Table 2). Four behaviors in the clusters defined by Frick et al. (1993) had no counterpart in the CBCL (i.e., "spiteful" and "blames others" from the aggression clusters, and "angry" and "breaks rules" from the opposition cluster and status violations cluster, respectively). We assumed that the small number of behaviors per cluster that were not covered by the CBCL were no real threat to the content validity of these clusters. Moreover the items "spiteful" and "breaks rules" are the items least discriminating between the destructive and nondestructive dimensions (Frick et al., 1993). The 2-week test-retest reliabilities ( $N = 91$ ) of the clusters are comparable to the reliabilities found for the original CBCL scales (i.e., aggression  $r = .75$ , opposition  $r = .75$ , property violations  $r = .83$ , and status violations  $r = .62$ , all  $ps < .01$ ).

Table 2

Item Description of the Externalizing Behaviors and Item Loadings From the Confirmative Factor Analysis

Frick clusters	CBCL items	Item loadings <sup>a</sup>
Aggression	Cruelty, bullying, or meanness to others	0.614
	Gets in many fights	0.684
	Physically attacks people	0.695
	Threatens people	0.732
Opposition	Argues a lot	0.724
	Disobedient at home	0.572
	Disobedient at school	0.812
	Stubborn, sullen, or irritable	0.778
	Sulks a lot	0.701
	Teases a lot	0.682
	Temper tantrums or hot temper	0.677
Property violations	Cruel to animals	0.636
	Lying or cheating	0.725
	Sets fires	0.631
	Steals at home	0.605
	Steals outside the home	0.543
Status violations	Vandalism	0.703
	Runs away from home	0.796
	Swearing or obscene language	0.573
	Truancy, skips school	0.497
	Uses alcohol or drugs for not medical purposes	0.907

Note. CBCL = Child Behavior Checklist.

<sup>a</sup>Average item loadings derived from the confirmative factor analysis of males and females on Time 1 (1983).

### Statistical Analyses

Analyses proceeded in three stages. First, to test the applicability of the Frick clustering of externalizing problems to the data, the CBCL items included in the proposed cluster were submitted to CFAs using M-plus 2.0 (Muthén & Muthén, 1998). The CFAs were conducted for each measurement moment and males and females separately. Model fit was determined using the goodness-of-fit index (GFI) and the percentage of explained variance. A model shows a good fit to the data if the GFI is larger than .90 (Hu & Bentler, 1999).

Second, the average course of the clusters was described using multilevel growth curve analyses (Longford, 1993). Multilevel models deal with the analysis of nested data. In a multiwave longitudinal sample, the repeated observations are nested within individuals. The multilevel model has two levels: one level for the repeated measures (between-subjects level) and one level for the individuals (within-subject level). The between-subjects level describes

the between-subjects variation with the use of the following parameters: intercept, gender, and age. The values of these parameters describe the average developmental trajectories for the total sample. The level for the individuals describes the unique characteristics of each individual participant in the study (i.e., the within-subject variation). In the multilevel models each individual was allowed to have his or her own developmental trajectory; that is, the individual growth parameters (intercept and slope) were allowed to vary across individuals. In that way the multilevel model allowed for estimation of the mean developmental trajectory (for the total sample) as well as the estimation of individual variation around this mean. For the estimation of the multilevel model, raw scores of the behavior scales were used.

The multilevel developmental trajectory models were estimated using (restricted) maximum likelihood estimation and an unstructured (co)variance matrix using the SAS PROC MIXED procedure (Littell, Milliken, Stroup, & Wolfinger, 1996). We followed the same procedure for each cluster. First, the baseline models were fitted, which consist of the intercept at the between-subjects and within-subject level. After estimating the baseline model, the successive models were built in a stepwise way. We built nested models at the between-subjects level with the parameters gender, age, age<sup>2</sup>, and the interaction term Gender  $\times$  Age. After deciding which model could be regarded as the best description of the data at the between-subjects level (the average developmental trajectory), we built the within-subject level (the variation around the average developmental trajectory) of the multilevel growth curve model in the same way. The significance of the improvement in fit of the nested models was tested with the chi-square difference test.

Third, the Frick clusters were submitted to a semiparametric mixture model-fitting procedure to identify groups of individuals who follow distinctive developmental trajectories within each externalizing behavior cluster. This model was proposed by Nagin and colleagues (e.g., Nagin, 1999) and is well suited for analyzing within-subject-level developmental trends. In the multilevel model the individual variation around the developmental trends is modeled at the within-subject level, assuming that with significant within-subject levels there are distinctive developmental trajectories within the population. Mixture models assume that the population is composed of a finite number of unobserved groups of individuals. The groups were defined by an expected developmental trajectory that relates the expected level of the behavior of interest with age. We assume

that trajectories are different from each other when there is significant variation in the intercept or slope or in a combination of variation in intercept and slope. Technically, we modeled this linkage between expected behavior and age up to a second-order polynomial equation. The parameters of this equation could vary freely across groups. We restricted the possible test per model to six different parametric representations of shapes of the group's trajectories (i.e., combinations of zero slope, linear slope, and quadratic slope). Model estimation was achieved by maximization of the likelihood that was derived in Roeder, Lynch, and Nagin (1999). This mixture model is based on the zero-inflated Poisson distribution, which intends to estimate trajectory models in which the response variable is an integer-value index or count. The response variables were the raw scores (which are categorical scores ranging from 0 to 14) of the externalizing behavior clusters. Because externalizing behavior is typically concentrated in a small fraction of the population, the distribution of the scores contained more zeros than acceptable under the Poisson assumption. Therefore, we used the zero-inflated Poisson distribution.

In addition to a depiction of the shapes of the group-based behavioral trajectories, another important output was an estimate of the probability that each individual belongs to each of the groups. Using this probability, individuals could be assigned to the group to which they have the highest probability of belonging. These analyses were conducted using the SAS PROC TRAJ procedure (Jones, Nagin, & Roeder, 2001). Final model selection required a determination of the number of groups that best describe the data. We used the Bayesian Information Criterion (BIC) as a basis for selecting the optimal number of groups for any given model. The model with the maximum BIC identifies the best explanatory model. The BIC rewards parsimony and therefore tends to favor fewer groups, but it is known to be consistent (Keribin, 2000). The difference in BIC value between the models can give evidence of how well the model with the highest BIC fits the data compared with the other models. After we decided which model had the highest BIC value we observed whether the model was better than the model above and below. A difference of more than 10 in the BICs obtained for two different models is considered very strong evidence against models with a higher BIC, a BIC difference between 6 and 10 indicates strong evidence against models with a higher BIC, and a BIC difference between 2 and 6 indicates positive evidence for the model with the highest BIC (Raftery, 1995). To find the model with the maximum BIC we tested for

each externalizing cluster models with two to five groups.

## Results

### Factor Analysis

The CFA indicated that the structure of the Frick clusters fit well to the data at each time of measurement. The average GFI was 0.92 for the males and 0.96 for the females. The average proportion of variance explained in the Frick clusters (52% explained variance for males and 55% explained variance for females) was also considerable. All item loadings on the Frick clusters were significant and ranged from 0.497 to 0.907 (see Table 2 for loadings in 1983).

### Average Developmental Trajectories of Externalizing Behaviors

Table 3 shows for each of the four behavior clusters the chi-square values for the fit of the tested models and for the baseline model of the multilevel model. All average developmental trajectories showed changes across age, and all final models showed a significantly better fit to the data than the baseline model, which included only an intercept at the between-subjects and within-subject levels. Later, we describe the trajectories that were estimated for aggression, opposition, property violations, and status violations, respectively, and that are depicted in Figure 1.

The final model ( $\chi^2 = 11,206.9$ ,  $df = 2,068$ ) for aggression showed a significantly better fit than the baseline model ( $\chi^2 = 12,116.3$ ,  $df = 2,074$ ;  $\Delta\chi^2 = 909.4$ ,  $\Delta df = 6$ ,  $p < .001$ ). The between-subjects level of aggression was dependent on an intercept, gender, age, and Gender  $\times$  Age effect. Aggression followed an average developmental trajectory that differed be-

tween males and females (gender effect), decreased linearly with increasing age (age effect), and decreased at a faster rate for males than for females (Gender  $\times$  Age effect).

The average development of opposition also showed a decreasing trajectory that was different for males and females (gender effect) and that was significantly different from the baseline model ( $\Delta\chi^2 = 285.3$ ,  $\Delta df = 6$ ,  $p < .001$ ). Males showed more oppositional behaviors than did females in childhood, and a larger decrease for males resulted in the same level of oppositional behaviors for males and females in adolescence (age and Gender  $\times$  Age effect). The age<sup>2</sup> effect for opposition influenced the steepness of the decrease of the average trajectory over time, with a faster average decrease in adolescence than in childhood.

The final model for property violations had a significantly better fit than the baseline model ( $\Delta\chi^2 = 444.2$ ,  $\Delta df = 5$ ,  $p < .001$ ). Property violations showed for both males and females the same linearly decreasing average development over age (age effect), but the level of reported property violations was higher for males than for females (gender effect).

The final model for status violations described the average developmental trajectories better than the baseline model ( $\Delta\chi^2 = 865.8$ ,  $\Delta df = 5$ ,  $p < .001$ ). Status violations was the only behavioral cluster that showed an average developmental trajectory with increasing problem behaviors over time. After an initial, slight decrease of status violations during early childhood, there was a steep increase after age 9 (age and age<sup>2</sup> effect). The decreasing trajectory in the earliest years of the study reflects mainly swearing and using obscene language. Across the age range of 4 to 18 years, males showed at average more status violations than did females (gender effect).

A multilevel growth curve model also incorporates the individual deviations from the average

Table 3  
Model Fit of Average Developmental Trajectories of Externalizing Behaviors

	Between-subjects level	Within-subject level	Final $\chi^2$	Baseline $\chi^2$	$\Delta\chi^2$	$\Delta df$
Baseline	Intercept	Intercept				
Aggression	Intercept, gender, age, Gender $\times$ Age	Intercept, gender, age, Gender $\times$ Age	11206.9	12116.3	909.4***	6
Opposition	Intercept, gender, age, age <sup>2</sup> , Gender $\times$ Age	Intercept, age, age <sup>2</sup>	29649.6	29934.9	285.3***	6
Property violations	Intercept, gender, age	Intercept, gender, age, age <sup>2</sup>	12858.5	13302.7	444.2***	5
Status violations	Intercept, gender, age, age <sup>2</sup>	Intercept, age, age <sup>2</sup>	11136.5	12002.3	865.8***	5

\*\*\* $p < .001$ .



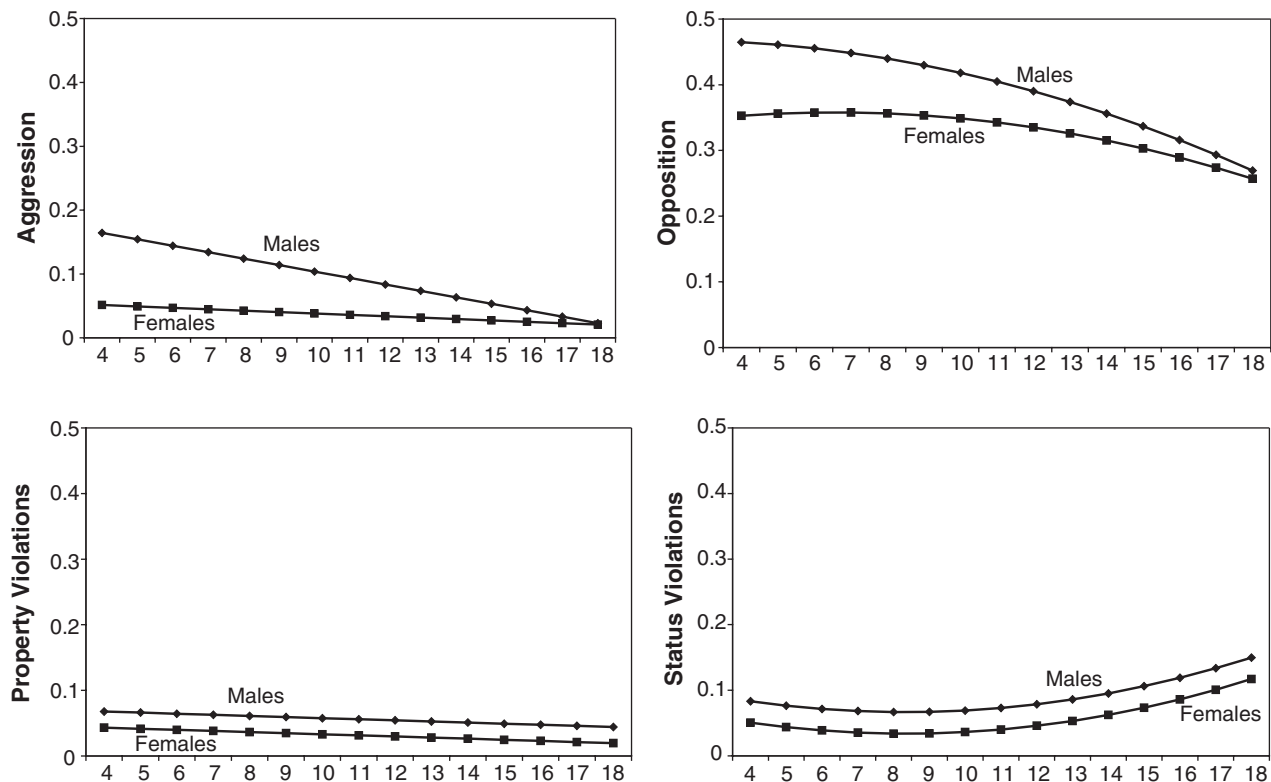


Figure 1. Average developmental trajectories of aggression, opposition, property violations, and status violations. Ages are shown on the *x* axis. The *y* axis represents the raw syndrome scores divided by the number of items in the scale.

developmental trajectory at the within-subject level. All within-subject models appeared to be dependent on age, indicating that there were differences between individuals in the development of these behaviors over time (see Table 3). Therefore, the next analysis incorporated the individual differences in the development of behaviors over time and identified different groups of children following a similar developmental pathway.

Table 4  
Bayesian Information Criterion of the Group-Based Developmental Trajectories

No. of groups	Aggression	Opposition	Property violations	Status violations
2	–3,586.08	n.t.	n.t.	–4,401.39
3	– <b>3,551.17</b>	–13,277.65	–3,901.07	–4,388.23
4	–3,555.05	–13,154.14	– <b>3,896.98</b>	– <b>4,384.48</b>
5	–3,566.10	–13,128.41	–3,906.33	–4,395.58
6		– <b>13,116.00</b>		
7		n.e.		

Note. The boldface values indicate the selected models. n.t. = not testable; n.e. = not estimable.

#### Group-Based Developmental Trajectories of Externalizing Behaviors

The results of the semiparametric mixed modeling approach to identify group-based developmental trajectories of externalizing behaviors are shown in Table 4. We present the BIC values of models for different numbers of groups using the same variation of trajectory shapes (zero slope, linear slope, quadratic slope). The model with the largest BIC value is the best model, printed in bold face. For aggression (BIC –3,551.17), the BIC suggested that there was positive evidence (a BIC difference of 34.9 points with the two-group solution and a BIC difference of 3.9 points with the four-group solution) that the three-group solution with all linear trajectories was the best model. For both property violations and status violations there was positive evidence for a four-group solution. For property violations the best model had a combination of linear and zero slope trajectories, and the best model of status violations had all linear slope trajectories. In the opposition cluster we also fitted a model with six and seven groups because no single best BIC value could be demonstrated in the models with two to

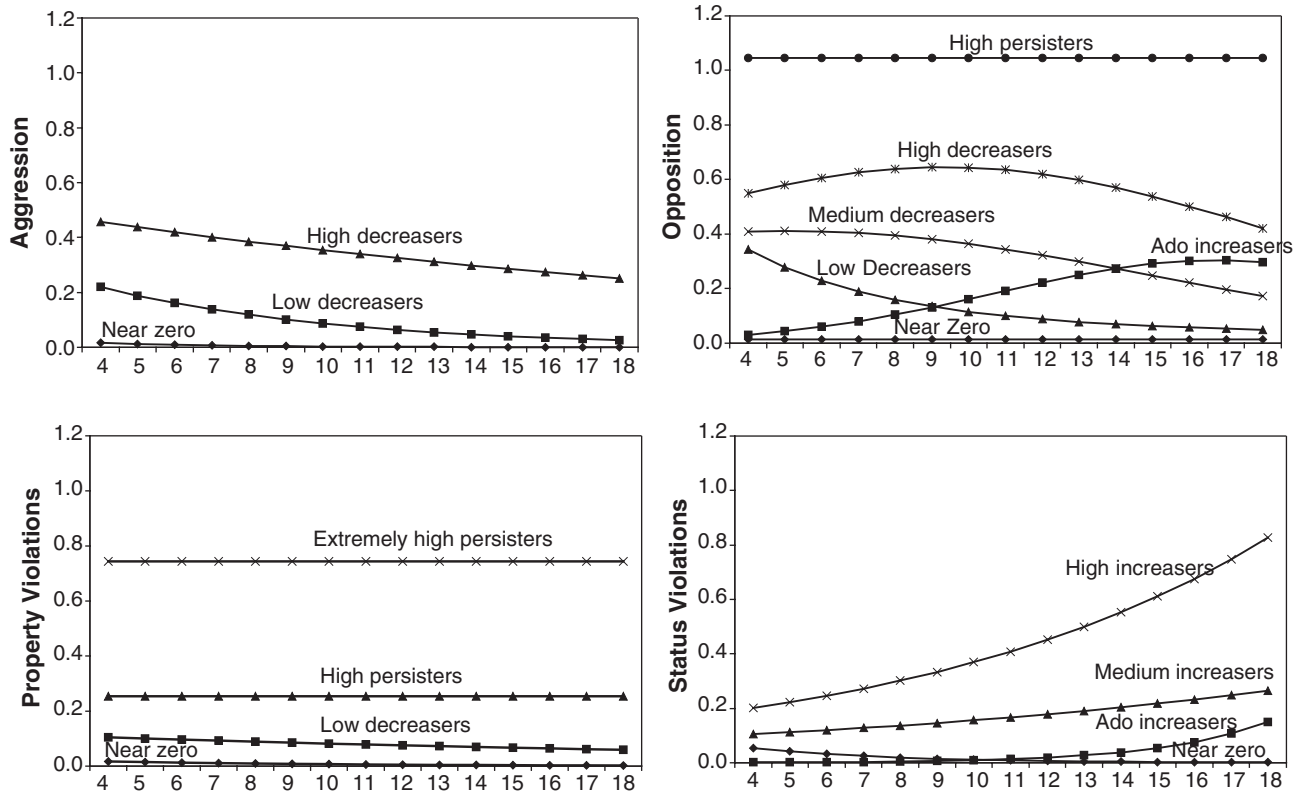


Figure 2. Group-based developmental trajectories of aggression, opposition, property violations, and status violations. Ages are shown on the *x* axis. The *y* axis represents the raw syndrome scores divided by the number of items in the scale.

five groups. The seven-groups solution did not reach convergence, which leads to the conclusion that the model with six groups and a combination of zero slope and quadratic slope trajectories is the optimal model for opposition.

We tested gender differences in the group-based developmental trajectories by adding a gender effect on the intercept and on the slope of all four best models. The effects of gender on the intercept were comparable to the effects of gender on the average developmental trajectories, with males showing higher levels of problem behavior than females. However, the shapes of the trajectories were similar across males and females. In only 4 of 17 cases we found gender differences in the slope of the trajectories. Given these minimal differences, we present the same models across gender.

As depicted in Figure 2, all trajectories in the optimal solutions for aggression showed a linear decrease, and for status violations a linear increase over time. The optimal solutions for both opposition and property violations showed a combination of stable and linear decreasing or increasing trajectories. The proportions of children and adolescents in each trajectory group are reported in Table 5.

All three identified trajectories for aggression (first panel of Figure 2) showed decreasing levels of reported physically aggressive behaviors, indicating that the developmental trajectories were dependent on intercept and age. The largest number of children, an estimated 71% of the sample, is represented in the near zero group for whom hardly any aggressive behavior is reported across the age period. The low decrease group (21%) included children who engage in medium-level aggressive behaviors during childhood and almost none in late adolescence. The smallest and most problematic high decrease group (8%) is described by a declining but high-level trajectory of aggressive behavior, indicating persistent aggressive behavior even in late adolescence.

The second panel of Figure 2 presents the developmental trajectories for opposition. Two groups showed nearly no oppositional behavior in adolescence and were designated the near zero and low decrease group, including approximately 7% and 24% of the sample, respectively. The reverse pathway was shown by the adolescence increase (6%), who showed very little opposition during childhood but increasing levels during adolescence. Two other groups, the medium decrease (33%) and the high

Table 5

Proportion of the Total Sample, Males, and Females in Each Developmental Trajectory (in Percentages) and Odds Ratios for Gender and Behavior Clusters

Developmental trajectories	Total sample (N = 2,076)	Males (n = 1,016)	Females (n = 1,060)	Odds ratio
Aggression				
Near zero	71.0	60.4	81.0	
Low decreaseers	21.4	28.5	14.5	2.6 (2.1–3.3)
High decreaseers	7.7	11.0	4.4	3.3 (2.3–4.8)
Opposition				
Near zero	7.1	6.4	7.8	
Low decreaseers	23.7	21.6	25.7	<i>ns</i>
Adolescence increaseers	6.0	5.1	6.9	<i>ns</i>
Medium decreaseers	32.5	33.4	31.6	<i>ns</i>
High decreaseers	24.2	26.5	22.1	1.5 (1.0–2.1)
High persisters	6.5	7.1	5.9	<i>ns</i>
Property violations				
Near zero	74.6	69.2	79.7	
Low decreaseers	20.3	23.3	17.4	1.5 (1.2–1.9)
High persisters	5.2	7.5	3.1	2.9 (1.9–4.5)
Status violations				
Near zero	50.7	45.3	55.8	
Adolescence increaseers	23.4	22.3	24.3	<i>ns</i>
Medium increaseers	24.8	30.6	19.2	2.0 (1.6–2.4)
High increaseers	1.2	1.8	0.7	3.3 (1.4–8.0)

Note. Odds ratios (95% confidence interval) are given as significant ( $p < .05$ ). Females and the near zero trajectory within each behavior cluster are the reference category for each reported odds ratio.

decreaseers (24%), also showed a decreasing trajectory from childhood to adolescence. The problematic opposition group, the high persisters (7%), showed nearly twice as much oppositional behavior throughout the measurement period as the next highest, the high decreaseers group. The near zero group and the high persisters group both followed stable trajectories and thus were only dependent on the intercept. All other trajectories within opposition were dependent on intercept and age.

The third panel of Figure 2 shows the four developmental trajectories found for property violations. There was a large near zero group (75%) of males and females who showed nearly no property violations throughout the measurement period. The low decreaseers (20%) showed declining property violations on a low level. The near zero group and the low decreaseers group within property violations were both dependent on intercept and age. The two highest groups, the high persisters (5%) and the extremely high persisters (0.3%) both showed persistent property violations on a high level and were thus dependent on intercept only, the 6 males and females in the extremely high persisters group being very deviant from all other individuals. Because the ex-

tremely high persisters group included less than 1%, we combined these two groups into one high persisters (5.2%) group for further analyses.

The last panel of Figure 2 depicts the four developmental trajectories found for status violations, which were all dependent on intercept and age. The near zero offenders were the largest group (51%), showing little status violations in childhood and none during adolescence. The other half of the sample showed increasing status violations over time, but at different levels. The adolescence increaseers (28%) started status violations by age 10, whereas they showed none before that age. The medium increaseers (25%) showed an increasing amount of status violations throughout the measurement period. A small group, the high increaseers (1%), showed highly deviant levels of status violations in adolescence.

To test our hypotheses on gender distribution across the group-based developmental trajectories, we computed odds ratios for each trajectory group using females and the near-zero trajectory within each behavior cluster as reference group. The proportions of the total sample, males, and females across the developmental trajectories and the odds ratios for the effect of gender are shown in Table 5.

This table shows that males were overrepresented in the problematic developmental trajectories of aggression, property violations, and status violations, whereas females were overrepresented in the low developmental trajectories. The problematic trajectories were between 2.9 and 3.3 times more common among males than among females, except for opposition. For opposition, the gender difference was less obvious than for the other behavior clusters, with only an overrepresentation of males among the high decreasers.

In the total sample, 175 males and 100 females were assigned to one or more problematic trajectories (i.e., a trajectory of continuously high scores constituting the smallest proportion of individuals within each cluster). Of these, 64% were assigned to only one problematic trajectory, 22% to two problematic trajectories, 11% to three problematic trajectories, and 4% to four problematic trajectories. Although more males than females were classified as having a problematic trajectory for aggression, property violations, and status violations (see Table 5), the distribution of individuals assigned to one, two, three, or four problematic trajectories was the same across gender,  $\chi^2(3) = 3.7, p = .297$ .

### Discussion

The objectives of this study were to test the applicability of the Frick clustering of externalizing behavior to children and adolescents from a broad age range and to describe the average and group-based developmental trajectories of four externalizing behaviors: aggression, opposition, property violations, and status violations. The study was conducted in a large longitudinal representative general population sample including multiple cohorts of males and females aged 4 to 18 years using assessments of externalizing behaviors by mainly the mothers of the participants, in contrast to studies that used at-risk samples (e.g., Loeber et al., 2000), measured males and females separately (e.g., Broidy et al., 2003), or addressed only childhood (e.g., Côté et al., 2001). The results from this study should be interpreted in light of the fact that only parent reports were used in the analyses.

First, we investigated whether the Frick clustering represents an acceptable description of externalizing behavior. The results confirmed its conceptual strength for both males and females and across a wide age range. The use of longitudinal data in this study not only allowed us to show the good validity of the Frick clusters but also to show that these clusters follow different average and group-based

developmental trajectories over time, supporting their distinctness. The main asset of this clustering lays in the further differentiation of externalizing problems, avoiding the lumping of behaviors that potentially show different developmental changes.

Using multilevel growth curve analyses, we demonstrated that the average development is different for these four types of externalizing behavior with higher levels for males than for females. We found decreasing average developmental trajectories for aggression, opposition, and property violations, and increasing trajectories for status violations.

Contrary to our expectation that aggression would peak at age 13 (cf. Lahey et al., 2000), we found that physically aggressive behavior was most prevalent in younger children. Aggression showed a decreasing trajectory over time, with nearly twice as much aggressive behavior reported for males than for females in childhood, but hardly a difference in late adolescence (cf. Crick & Dodge, 1996; Keenan & Shaw, 1997). This study also demonstrated that the difference in aggressive behavior between girls and boys is likely to have risen even before age 4, which runs counter to the assumption of no difference before elementary school (Keenan & Shaw, 1997). Our results also suggest that physically aggressive behaviors in childhood and adolescence tend to be transitory and, for most individuals, largely resolved by the beginning of adulthood.

Similarly, and confirming our expectations, we found decreasing average developmental trajectories for opposition. In childhood, males showed more oppositional behavior than females, but this gender difference evaporated in adolescence. Lahey et al. (2000) did not detect gender differences in oppositional behavior but assumed that this was caused by a lack of statistical power, which was no problem in the present study.

Contrary to our expectation, we found a decreasing trajectory for property violations with higher levels for males than for females. Although this average decrease may be real, it is possible that parents are well aware of their child's minor rule-breaking behavior, such as lying, but less aware of more serious forms, such as stealing and vandalism, especially as their child enters adolescence.

As expected, we found an increasing average developmental trajectory for status violations, with males showing higher levels than females. This pattern is similar to the one found by Lahey et al. (2000) in a cross-sectional design. However, we did not expect that all children follow the average trajectories we found for the externalizing behaviors. Numerous studies already indicate that there are

children and adolescents who follow different developmental patterns, for instance, the two developmental patterns proposed by Moffitt (1993). Therefore, we also identified group-based developmental trajectories.

Within each behavior cluster there were three to six group-based developmental pathways, most of which followed the shape of the average trajectories at various levels. Within each behavior cluster, a large group of individuals was identified who followed a developmental trajectory at a low level, indicating that most individuals exhibit very little externalizing problem behavior as reported by the parents. All trajectories for the aggression cluster decreased with age. Half of the trajectories for opposition and property violations decreased with age as well, as did one for status violations. We found two stable trajectories for property violations and two for opposition. Three of the four trajectories for status violations and one for opposition increased with age. Although the shape of the trajectories did not differ for males and females across the age period, more males than females followed high-level trajectories of aggression, property violations, and status violations. By contrast, for opposition we only found a gender difference for the high decreasers group's trajectory that included somewhat more males.

As expected, we found declining trajectories for aggression, indicating that both males and females show most aggressive behavior in childhood, which is congruent with many other studies (e.g., Broidy et al., 2003; Campbell, 1995; Tremblay, 2000). For most children, aggressive behaviors disappear in adolescence as shown by the near-zero amount of aggressive behavior in adolescence for the low decreasers group, confirming findings from a study by Brame et al. (2001). The children who deviated most from average development, the high decreasers group, showed serious aggressive behavior throughout the measurement period; moreover, the level of aggressive behaviors at age 18 was higher than the level of the low decreasers group at age 4.

Unexpectedly, not all trajectories for opposition decreased with age. The lowest and the highest trajectories showed a stable course, and we found one small group (6%) with increasing opposition in adolescence. These youngsters seem to follow trajectories comparable to the adolescence onset or escalating trajectories described in other studies (e.g., Gorman-Smith, Tolan, Loeber, & Henry, 1998; Moffitt, 1993; Patterson & Yoerger, 1993). Because the largest trajectory group for opposition was not the group of children who show no oppositional behavior at all, we can assume that it is normative for

parents to observe some oppositional behavior during both childhood and adolescence. Other studies reported similar findings for males (Nagin & Tremblay, 1999, 2001a). This is the first study to confirm this phenomenon for females.

Contrary to our expectations of an increase of property violations during adolescence (cf. Moffitt, 1993), we found stable or decreasing trajectories with an early onset. Several studies (e.g., Loeber et al., 1993; Moffitt et al., 2002; Nagin & Tremblay, 2001a; Tremblay, 2000) showed that property violations reported by informants other than parents increase with age, especially in the most problematic group. Our findings should be interpreted in the light of the fact that only parent reports were used, potentially missing behaviors that may be better reported by, for instance, youngsters themselves or peers.

As expected, we found increasing trajectories of status violations for about half of the participants. Earlier studies indicated that alcohol and drug use and truancy tend to start in early adolescence (Tremblay, 2000). However, our results show that an increase in status violations is not as normative as sometimes suggested (e.g., Moffitt, 1993), considering that the other half showed decreasing trajectories.

Of those whose development followed a problematic trajectory, 64% were deviant on only one of the behavioral clusters. The other 36% (or 99 individuals in the present sample) were likely to follow two, three, or even four problematic trajectories. It might well be that, for example, the high persisters within opposition were also the high increasers within status violations, lending support to Loeber's (Loeber et al., 1993) and Tremblay's (2000) perspectives on the development of delinquent careers. The analyses reported in this article may be used as a starting point to identify classes of developmental trajectories that may converge with these perspectives.

### *Gender Differences*

The present study indicates that the shape of the developmental trajectories hardly differs between males and females. Several studies found comparable results for childhood and adolescence onset antisocial behavior (Fergusson & Horwood, 2002; Moffitt, Caspi, Dickson, Silva, & Stanton, 1996), suggesting that despite differences in overall levels of externalizing behavior, the developmental pathways are the same for males and females, at least in the Netherlands and New Zealand. Apparently, females showing deviant levels of externalizing behavior follow developmental pathways similar to deviant males.

Despite the lack of differences in the group-based developmental curves for males and females, there are gender differences in mean numbers of reported problem behaviors. Studies indicated that males are more prone to receive a CD diagnosis than females in a ratio of 4:1, although the gender difference in frequency of ODD diagnosis is not that obvious (McDermott, 1996). Similarly, in the present study the chance of following high-level trajectories was higher for males than for females, especially for CD-like behavioral clusters (aggression, property violations, and status violations). Research also suggested that the most obvious gender difference can be found for physically aggressive behaviors (e.g., Crick et al., 1999). In the present study, all CD-like behavioral clusters showed nearly the same gender difference (Table 5). This indicates that the gender difference in CD is probably not caused by a single behavioral cluster but by all relevant behaviors together.

### *Theoretical Implications*

This study has possible implications for Moffitt's theory of the development of antisocial behavior (Moffitt, 1993; Moffitt et al., 1996). Similar to other studies (e.g., Brame et al., 2001; Fergusson & Horwood, 2002; Lacrouse et al., 2002; Nagin & Tremblay, 1999) we could not identify the so-called adolescence limited group. The limited number of individuals who showed increasing trajectories of opposition and status violations did not reach the level of the identified problematic trajectory (that showing the highest level of problem behavior throughout).

In addition, our results seem to contrast with some of the assumptions forwarded in the theory of antisocial development proposed by Loeber et al. (1993). According to Loeber's model of antisocial development, high levels of opposition in childhood would be expected to be followed by increasing levels of aggression, property violations, and status violations later on. Although we did not model sequential patterns of behaviors, the identification of early childhood high levels of aggression and property violations in the present study does not fit Loeber's perspective of behavioral sequences.

Several reviews of the development of externalizing behaviors suggest that behaviors related to the diagnosis ODD become less common after the transition from childhood to adolescence (e.g., Campbell, 1995), whereas studies suggest behaviors related to the diagnosis CD increase (especially covert behaviors; e.g., Tremblay, 2000). Although oppositional behavior indeed showed a slight developmental decrease, behaviors represented by the opposition

cluster remained more common than those represented by the aggression, property violations, and status violations clusters (these three clusters combined reflecting behaviors tapped by the diagnosis CD). In this sample, opposition also remained more common in adolescence than covert externalizing behaviors, represented by the property violations and status violations clusters. Again, it is possible that parents were unaware of their children's covert antisocial activities.

### *Study Limitations and Further Research*

The present study is not without limitations. A main limitation is that the study population was a random sample of mainly Caucasian children and adolescents living in the Netherlands. It is uncertain to what extent cultural differences may be responsible for differences in the course of problem behavior. Crijnen, Achenbach, and Verhulst (1997) compared CBCL scores for 12 cultures and concluded that cultural effects on average levels of parent-reported problem behavior were minimal. However, this conclusion may not translate to the developmental course of problem behavior. Another limitation of this study is the reliance on only parental reports to assess psychopathology. Parents may be unaware of their child's rule-breaking behavior and offenses, especially as their child becomes an adolescent (Moffitt et al., 1996). Therefore, replications are essential to assess the generalizability of the present findings to other informants such as teachers and youth themselves.

Because of the use of the CBCL, we could not describe externalizing behavior that is more relevant for females, such as relational aggression. However, our results indicate that the externalizing behavior that is assumed to be more often exhibited by males also has considerable levels in subgroups of females. It might well be that gender differences would have been absent or reversed had relational aggression been included in this study.

Although the study results were obtained from a fairly large sample of about 2,000 children and adolescents, some of the identified trajectory groups were small. However, the descriptive value of the study is not affected by the finding of small groups, which may be regarded to represent validly the distribution of longitudinal trajectories in the population. Also, the longitudinal trajectories described cover an age range from 4 to 18 years, whereas the maximum age range covered by any participant was only 8 years.

This study's results also suggest a number of potential directions for future research. First, the cross-setting generalizability of the trajectories found in this study needs to be investigated. Teachers and youth themselves may have a view of children's problem behaviors that is different from parents' views, because of both situational and informant factors. In addition, it is important to identify cross-situational replicable trajectories because children who show cross-situational behavior problems often have more severe and stable behavioral difficulties than do children who show problems in one setting only.

Second, in further research the predictive power of the present method of creating subgroups of individuals based on a statistical criterion instead of arbitrary cutoff points for being deviant versus nondeviant could be tested. Using the developmental trajectories instead of cutoff points can give new impulse to the research of the predictive relations between child and adolescent externalizing behavior and psychopathology or other outcomes. For instance, it is interesting whether children who develop a problematic developmental trajectory have an increased risk for developing psychiatric disorders. In addition, the presence of trajectory classes might be addressed (e.g., through latent class analysis) to get a view of the co-occurrence of high-level externalizing trajectories. These classes can indicate whether there are clusters of high-level externalizing behavior that have a stronger predictive relation with psychopathology than other clusters of externalizing behaviors.

Third, it is highly important to learn more about potential causes of and causal mechanisms affecting the developmental trajectories identified in this study. We showed that children with externalizing problems are most likely to be adolescents with problem behaviors. The long-term consequences of externalizing problem behavior in childhood and adolescence support the importance of early intervention and prevention. Revealing mechanisms that account for the persistence of externalizing problems from childhood to adolescence contributes to the development of effective interventions and preventions. New studies may profit from the approach taken in this study to find trajectories in the development of psychopathology.

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